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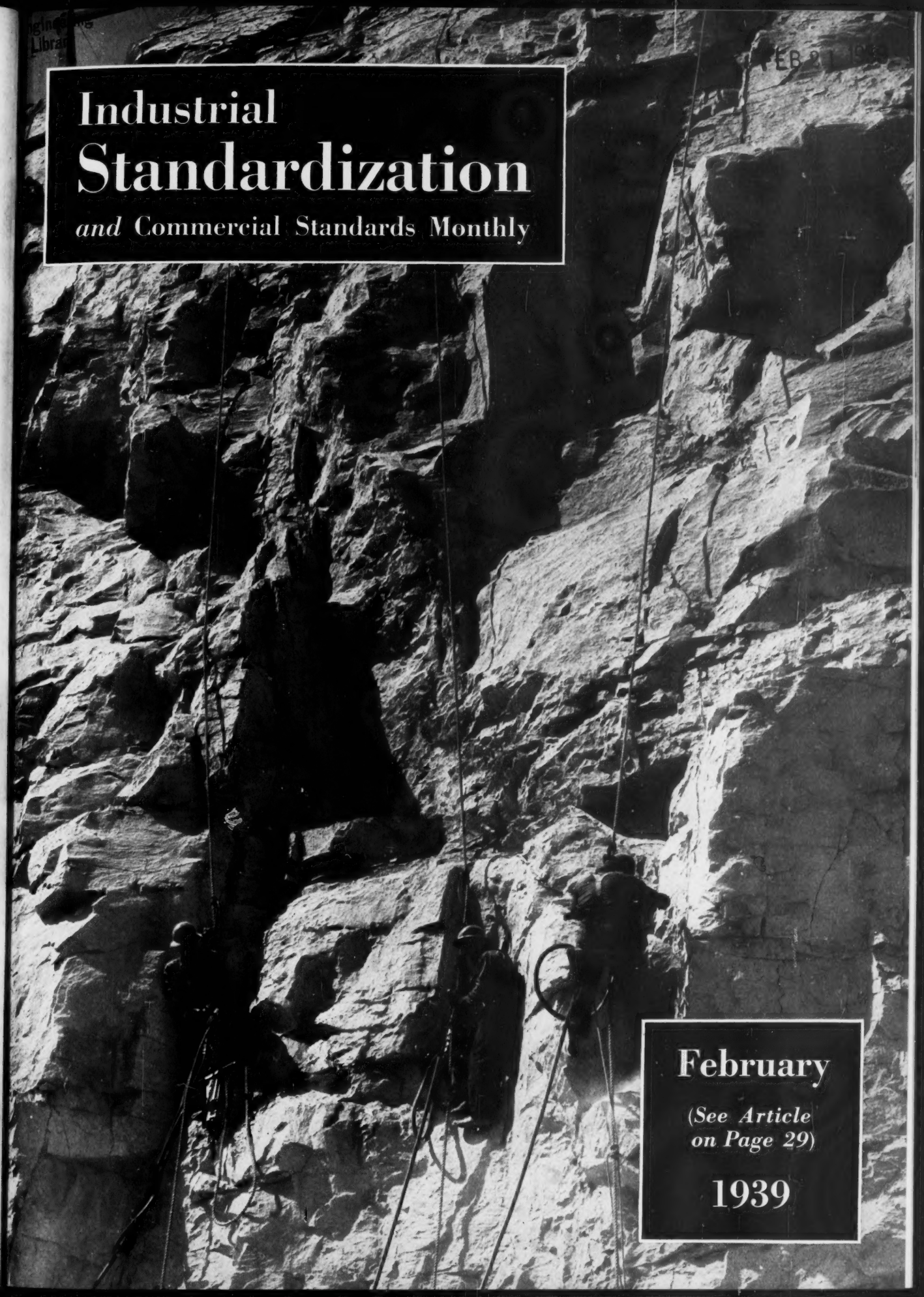
and Commercial Standards Monthly



February

(*See Article on Page 29*)

1939

For the Sake of Safety

A SAFETY CODE for Compressed Air Machinery and Equipment was recently approved by the American Standards Association. This makes the 61st national safety code developed by American industry under the procedure of the American Standards Association.

These codes designate guards for punch presses, and safety devices for elevators. They specify safe methods for construction, for forging and stamping hot metal, for mining coal, for the use and protection of grinding wheels. How many deaths and injuries these codes have actually prevented, no one can say; but their development and use has played an important part in the national movement to make machinery and mill and factory safe for the worker.

In the early nineteen hundreds fatal industrial accidents were occurring at a rate of more than 2,900 a month—a death for the erection of every floor of a new skyscraper, one for every new mile of railroad track laid. There were attempts on the part of many different groups to stem this slaughter. By 1912 it had become a political issue. The next few years saw the awakening of a safety consciousness on the part of industry and rise of workmen's compensation and of state industrial regulations. By 1919 so many conflicting standards and recommendations and laws were in existence that the American Standards Association was asked to serve as national clearing house for the work of the different groups.

Employers, employees, government groups, insurance companies, and safety organizations have all pooled their experience and knowledge in the development and constant revision of these national safety codes under the procedure of the American Standards Association. The work today guides companies in their own safety programs, and has done much to unify the various state and federal laws, and insurance requirements.

Safety code work constitutes an important part of the ASA program. In addition to the technical committees working on specific safety problems, a Safety Code Correlating Committee, on which sit the representatives of many national organizations interested in safety problems, supervises the whole activity. Every group at interest has a voice in the development of these codes, and this, no less than the hard work and sincerity of the trade associations, governmental and other national agencies taking part in the work, has given the codes nation-wide acceptance.

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RUTH E. MASON, *Editor*

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Drilling with compressed air on Grand Coulee Dam. Photo, Charles Philps Cushing

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ASA

Standardization is dynamic, not static. It means not to stand still, but to move forward together.

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February, 1939 **Vol. 10, No. 2**

New Code Recommends Safe Practices For Compressed Air Equipment

by

Dan L. Royer[1]

Chairman, Sectional Committee on Compressed Air Equipment and Machinery

COMPRESSED air has come to have a very broad use today. Garages, rock drills, excavating equipment, mining machinery, and a wide range of industrial applications give compressed air equipment an extraordinarily wide use at the present time.

When properly installed and used, compressed air equipment is perfectly safe, but inasmuch as most of the useful pressures are relatively high and also because air expands greatly under pressure, compressed air machinery and equipment must be installed and operated with care.

The compressor itself must be designed for the service to which it is subjected. Piping and receivers must have ample strength for safely carrying the pressures to which they are subjected.

(Text continued on page 32. See also pages 30 and 31.)

[1]Chief Engineer, Ocean Accident and Guarantee Corp., Ltd., New York.

National Organizations Developed New Code

Many national organizations had a part in the development of the Safety Code for Compressed Air Machinery and Equipment (B19-1938), under the administrative leadership of the American Society of Mechanical Engineers, and the American Society of Safety Engineers—Engineering Section—National Safety Council. Members of the sectional committee for this code are:

D. L. Royer*, American Society of Safety Engineers, Engineering Section, National Safety Council, *Chairman

W. D. Keefer*, National Safety Council, *Secretary

American Society of Mechanical Engineers, *H. H. Judson*
American Society of Safety Engineers, Engineering Section, National Safety Council, *Dan L. Royer*
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Member-at-large, *Charles W. Gibbs*

Courtesy Ingersoll-Rand Company

Hoisting heavy machinery, once responsible for many strained backs and mashed fingers, now easy and safe with compressed air

ASA Approves Safety Cod For

The Safety Code for Compressed Air Machinery and Equipment (B19-1938), approved in December by the American Standards Association, recommends safe practices in installing, maintaining, and operating compressed air equipment. It is designed for use by concerns manufacturing or using compressed air machinery and equipment as well as to serve as a guide to state authorities in formulating state safety rules and regulations. It was prepared with the idea that it might be adopted by any company as a standard to be followed by its superintendent, foremen, designers, mechanics, and operators.

The code applies to compressed air machinery and equipment, such as air compressors of the positive displacement type (both stationary and portable), air receivers, piping systems, pneumatic hammers, pneumatic drills, and other equipment for providing and

Courtesy Ingersoll-Rand Company

Mechanics using compressed-air-driven chipping hammers in a modern machine shop

Courtesy Ingersoll-Rand Company

Tightening nuts with air-driven impact wrenches on a railroad bridge

Code For Compressed Air Machinery

using compressed air in operations such as cleaning, drilling, hoisting, and chipping. It does not, however, cover special problems connected with the use of compressed air to convey materials nor those created when men work in compressed air as in tunnels and caissons, nor does it apply to compressed air machinery and equipment used on transportation vehicles.

The code was developed under the administrative supervision of the American Society of Safety Engineers—Engineering Section, National Safety Council; and the American Society of Mechanical Engineers.

Copies are available from the American Standards Association at 30 cents each. Members of the ASA are entitled to 20 per cent discount when ordering approved American Standards through the ASA office.

Courtesy Spencer, White & Prentis

Using compressed air to do the heavy drilling in a section of the new Sixth Avenue subway tunnel

Courtesy Ingersoll Rand Company

Miners using compressed air machinery in a drift of a western lead mine

Courtesy Ingersoll-Rand Company

A portable compressor used in street repair work

(Continued from page 29)

Control and safety devices must be provided and must be designed for the service that is required of them. Hose connections and utilization equipment must be properly handled if serious accidents are to be avoided. Proper operation, maintenance, and lubrication are of equal importance.

Many accidents have resulted from the misapplication of compressed air equipment, the installation of unsuitable, unsafe, or faulty equipment, and the failure to maintain and operate equipment safely. Because of these accidents, a number of states and municipalities have already adopted regulations for compressed air machinery and equipment.

Although there have been explosions and failures of pipe lines, hose connections, and utilization equipment, it is believed that most of the accidents have been caused by the explosions of compressed air receivers. In some instances the inherent design was faulty. The use of tanks and containers of either welded or riveted construction, that were never intended for compressed air service, has been a prolific cause of these accidents.

It is believed that the safety code for compressed air machinery and equipment is an answer to the question "What shall I do to make my compressed air machinery safe?" The code will answer the question of those who are installing compressed air equipment and who need information regarding safety requirements for all parts of the system. It will prove a valuable guide to those who are revamping compressed air systems that have already been installed. The code will be found easily understandable, direct, and without superfluous or impractical requirements.

SAE Elects Davidson President for 1939

W. J. Davidson, General Sales Manager, Diesel Engine Division, General Motors Sales Corporation, was elected president for 1939 by the Society of Automotive Engineers at the Annual Meeting of the Society in Detroit during the week of January 11.

W. J. Davidson

Mr. Davidson has been associated with General Motors in responsible technical capacities since 1914, except for the World War period when he served in France as a captain in the Motor Transport Corps. The French Government honored him with a Cross of the Legion of Honor in 1934.

Mr. Davidson was executive secretary of the General Technical Committee of General Motors when the General Motors Proving Ground was built and put into operation under the direction of that Committee.

As president of the SAE, Mr. Davidson succeeds C. W. Spicer, who will serve on the Society's Council as past-president.

The Society of Automotive Engineers is a Member-Body of the American Standards Association, and is represented on the ASA Standards Council, as well as on the Mechanical Standards Committee, and on many of the sectional committees working under the procedure of the American Standards Association.

Australian Code Guides Design And Operation of Cranes, Hoists

A code to serve as a guide for design and safe operation of cranes and hoists was issued recently by the Standards Association of Australia. The code, which covers not only design and manufacture, but also maintenance and handling of cranes and hoists, is to form one of a series now being prepared by the Association.

How American Standards Are Produced

The "What" and "Why" of ASA Procedure

by

R. P. Anderson[1]

Chairman, Committee on Procedure, American Standards Association

Note by Author: When I was requested to prepare an article for INDUSTRIAL STANDARDIZATION on ASA procedure, my mind reverted to the lengthy discussions in the Committee on Procedure and in the Standards Council that preceded the adoption of the latest Rules of Procedure published late in 1937, and I wondered why there appeared to be need for further elaboration.

It was explained that the suggested article would be especially for those readers of INDUSTRIAL STANDARDIZATION who observe the work from a distance and who may not fully appreciate just how the ASA differs from a technical society or a trade association. The ASA operates according to specific rules of procedure to develop standards in which everyone concerned has the opportunity to put forward his point of view, and a general understanding of this procedure is highly important.

So I proceeded to arrange a conversation with my neighbor Ted, an intelligent business man who knows something about standardization and is curious to learn more. Fortunately, or unfortunately for him, he didn't have to be present and may never know what he missed—or escaped.

[1]Dr. Anderson, who is secretary of the Division of Refining, American Petroleum Institute, New York, is vice-chairman of the Standards Council of the American Standards Association and chairman of the Committee on Procedure and Administrative Problems.

SCENE: ***Livingroom of suburban home.***
TIME: ***After dinner, January 26, 1939.***

Ted: Andy, I read in my evening paper a few weeks ago about the annual luncheon meeting of the American Standards Association. I have heard of many associations but this one is new to me. Can you tell what it is about in words of one syllable with not too much high-brow language?

Andy: (Thinking: This will be a new experience for me. Heretofore, I have been discussing ASA procedure with those who know more about it than I do, but here is an opportunity to reduce it to simplest terms. I'd better quit stalling and answer the man's question.) W-e-l-l, Ted, the American Standards Association—ASA for short—is tops in the field of standards in this country. You probably agree that standardization is important, perhaps without realizing how it affects many phases of our everyday life. For example, we take it for granted that a green traffic light means "Go" whether it beckons us on in Maine or in California. This is a very simple example of standardization and yet it wasn't always that way. At one time in the city of New York, a green traffic signal meant "Stop."

The need for standards naturally results from our industrial development and the ASA provides

facilities for standardization of anything from the sizes of children's clothing to requirements for electrical wiring in our homes; from the thread in milady's hose to the thread on domestic water piping, providing all concerned want the particular item standardized and can agree upon what the standard shall be.

This idea of agreement is the backbone of our association. The ASA furnishes the rules of procedure under which all the groups concerned can air their opinions and come to an agreement on the standards they want.

Ted: How are these rules decided on?

Andy: By the members themselves. About 20 years ago trade associations and technical societies found that they were setting up conflicting standards, and it was costing them money. So they decided to get together with departments of the Federal government in a federation where they could pool their ideas and work together according to rules agreed upon among themselves.

Ted: Who pays the bill?

Andy: Industry,—because standardization pays. Consequently, financial support of the ASA may be considered a profitable investment rather than an item of expense.

Ted: How does the ASA operate—how are its standards produced?

Andy: There are three methods that may be used. They are all based on the idea that any organization concerned with a standardization problem may be represented and have a voice in the development and acceptance of a standard.

I think we'd better take up the simplest method first, even though it is not so widely used. One or more organizations may propose that a standard be developed. A conference of those interested may be called and if it seems feasible, a proposed standard may be formulated by the conference and submitted to all interested groups for approval. If favorable action is taken, the proposed standard is submitted to the Standards Council. If approved by the Council, the standard is published as an American Standard. This method is intended to be used in simple cases where there are no important differences of opinion, and is known as the General Acceptance Method.

The second method begins with a standard of some other organization. The organization may submit one of its standards to the ASA, with a statement giving complete information about how the standard was prepared, listing those concerned with its preparation, and showing the extent to which it has been accepted by those interested. If the Council finds that its requirements for general acceptability have been met, the standard may be approved as an American Standard. This is the Existing Standard Method.

The third method begins with a proposal by one or more organizations that a standard be developed. A conference of those interested is called to find out whether they agree that it is desirable to undertake the job. If the conference agrees that it should be done and the Standards Council acts favorably on the recommendation, a committee is organized for the purpose. Care is taken to include everybody interested. Ordinarily, one of the organizations is asked to assume responsibility for the administrative leadership of the program. That organization is designated as sponsor. When the committee has completed its assignment, its recommendations are transmitted by this "sponsor" organization to the Standards Council for approval. Such a committee is known as a Sectional Committee because it represents a cross section of interested organizations. This method is known as the Sectional Committee Method.

Ted: Wait a minute! All this brings up some questions. First of all, what is the Standards Council?

Andy: Well, the Standards Council is made up of representatives of all the trade associations, technical societies, and departments of the Federal government that are members of the ASA. It decides what work the ASA shall undertake, and acts as a court to pass on approval of standards.

Ted: I can't see how you can expect any body of men to pass intelligently on the wide variety of proposed standards that must be presented to it.

Andy: I'm glad you raised that question. The primary job of the Council is to determine whether all groups interested in a proposed standard have indicated their acceptance of it. Actually it decides whether the rules agreed upon have been followed. If that is the case, there is no doubt but what the proposed standard is suitable for approval as an American Standard. As a matter of fact, though, the Standards Council is so large that it has had to organize a number of committees operating in specific fields to assist it in reviewing the records of the development of proposed standards submitted for approval. These groups are generally known as correlating committees. There are seven of them, working on building, highway, mining, safety, electrical, mechanical, and consumer-goods problems.

Ted: Why do you need these three methods for developing standards?

Andy: To provide flexibility in procedure to meet varying conditions in industry. However, the General Acceptance Method is used only infrequently, while the Sectional Committee Method represents the usual procedure.

Ted: Don't you ever need to revise these standards?

Andy: We surely do. Standardization would cease to be worthwhile if we couldn't keep abreast of progress.

In the case of standards developed by a sectional committee, the committee continues to exist after a standard has been developed and approved. The committee takes up suggestions for revision of the standard and if they meet with approval in the committee the revised standard is presented to the Council for approval.

In the case of standards approved under the Existing Standards Method, the organization that originally prepared the standard may be given the responsibilty of preparing the revision and may be assigned what we call "proprietary" sponsorship for it. Sometimes, however, sectional committees are organized to take care of revisions of these standards. An organization may also be assigned proprietary sponsorship for the revision of standards prepared under the General Acceptance Method, although again sometimes sectional committees are organized.

Ted: You spoke about an organization acting as "sponsor." What does that mean? Can't a committee act by itself without a sponsor?

Andy: Yes, it can, and in some cases it does. But the reason for the "sponsor" organization is that a great deal of administrative work must be done in carrying on the work of a committee and the organization which accepts sponsorship takes on the responsibility for carrying on that work. It actually becomes sort of a foster parent of the committee, and can greatly help the work by continually encouraging the committee. It also takes the responsibility for seeing that any controversies are solved satisfactorily before the proposed standard is sent to the Standards Council. The choice of a sponsor organization is naturally important in the satisfactory development of a standard.

Ted: Hmm, I should think it might be. But there must be a great deal of general administrative work not done by the sponsors that is needed to keep the whole program functioning smoothly, isn't there? Does the Association have to maintain a large staff to handle that part of the work?

Andy: Well, the staff is made up of a group of engineers and the usual stenographic and clerical assistants. The staff does some of the administrative work for the committees and assists the sponsors in carrying out their administrative program. It also coordinates and correlates the work of all the sponsor organizations. There are about 140 ASA committees, and about 3,000 people participating in the work of these committees. You can see that it takes a good deal of work to maintain all the records in connection with such extensive operations.

Ted: What advantage is it to an organization that develops its own standards to have them approved as American Standards?

Andy: Approval by the ASA has been accepted to such an extent that it has gained national significance. ASA approval is really a certificate for the national character of the standard.

Ted: Yes, I see. It shows that it is a real *American* standard.

Andy: That's the idea. There is another point too. The use of a standard is widened through its approval as an American Standard. And its designation as an American Standard gives it a prestige which, added to the prestige of the organization which originally prepared it, greatly increases its value as a tool for industry to use.

Ted: Does the ASA develop standards only for companies or organizations who are members of the Association or who pay for the work?

Andy: No. An organization does not need to be a member in order to propose a project or to take part in the program. Membership in the ASA, however, naturally results when there is a real understanding of the value of standardization and a willingness to do one's bit to bring it about.

Ted: That sounds reasonable. I think I've got a pretty fair idea of what sort of an organization the ASA is and how it works, but, no doubt, I will have more questions as I think over what you have told me. Must run along now as I promised to take Junior to the movies. I hope we may continue this later. Good-night, and thanks.

Andy: Good-night, Ted. I'll be glad to go over this in more detail when it suits you. *(Ted exits.) (Soliloquizing:* Whew! That's over, and I didn't once use our favorite word "consensus." Probably I tried to cover too much ground in a few minutes, and, at that, I omitted much of the detailed requirements of our rules of procedure. Probably he would have felt that they weren't important and perhaps he would have been right. But, as in the preparation of standards, that is a matter for discussion and compromise—and ***concensus!)***

Texas to Rate School Lighting by American Recommended Practice

The Texas State Board of Health is planning to use the American Recommended Practice of School Lighting, approved last year by the American Standards Association, as a guide in rating the schools under its jurisdiction on their lighting systems, according to the *Transactions of the Illuminating Engineering Society*, January, 1939.

The American Recommended Practice for School Lighting (A23-1938) was prepared under the administrative leadership of the Amer. Institute of Architects and the Illuminating Engineering Soc.

Courtesy General Electric Company

These two pictures show how different lighting arrangements may change the efficiency of a workroom

Proposed Code Revision Recommends Minimum Light for Factories

Committee Asks Comments and Suggestions before Approval of Draft Standard

RECOMMENDATIONS for higher minimum light in factories and work places as a means of reducing accidents, cutting down fatigue, increasing quality as well as quantity of production, and contributing to harmonious industrial relations are being proposed as a revision to the American Standard Code of Lighting Factories, Mills, and Other Work Places approved by the American Standards Association in 1930.

Since approval of the original standard, the Illuminating Engineering Society reports, developments in lighting research and practice have made the standard obsolete. The IES has the administrative leadership for the work of the ASA sectional committee. Through its Committee on Industrial and School Lighting it has prepared the suggested new changes in the Code in the form of a draft standard for consideration by the committee. After comments and suggestions have been received, and if the recommendations are approved by the sectional committee and the IES, the draft will be submitted to the American Standards Association for approval.

Minimum illumination in foot-candles is recommended in the proposed revision for various processes in 47 different industries. The list has been enlarged since the approval of the 1930 standard to include the cleaning and pressing industry, aeroplane hangars, as well as greatly expanded recommendations for the printing industries, shoe manufacturing, steel and iron manufacturing, and silk and rayon manufacturing.

An analysis of four groups of especially difficult seeing tasks includes detailed lighting recommendations for each group and reasons for these recommendations.

In addition to the foot-candle recommendations, other sections tell how to maintain the lighting system, how to use daylight facilities to the best advantage, how to control general lighting, and how to provide for adequate electrical wiring.

The recommendations for foot-candles are based on studies of illumination needs of specific industries which the Illuminating Engineering Society has been carrying on in recent years. In industries where reports of the IES studies have not been completed the values recommended are based upon current good practice.

"Within the past few years a new understanding of the science of illumination has developed," says the IES in its foreword to the new recom-

mendations. "Today we look upon our illumination problems in terms of seeing: How much and what kind of light is necessary to give us proper illumination for our seeing tasks?

"The beneficial effects of good illumination, both natural and artificial, have been established in extensive tests over many years. The advantages to industry from this improved personal efficiency of its employees are many:

1. Greater accuracy of workmanship, resulting in an improved quality of product with less spoilage and rework.
2. Increased production and decreased costs.
3. Better utilization of floor space.
4. More easily maintained cleanliness and neatness in the plant.
5. Greater ease of seeing, especially among older, experienced employees, thus making them more efficient.
6. Less eyestrain among all employees, with its possibilities of more serious eye troubles.
7. Improved morale among employees, resulting in decreased labor turnover.
8. Fewer accidents.

"Under good illumination it is possible to see an object of approximately half the smallest size discernible under poor illumination. Thus with articles of precision manufacture, a much closer visual check can be made throughout the manufacturing process. Slight defects which would otherwise be seen only at the final inspection and result in rejection at that time can be avoided or are seen as they occur.

"An increase in illumination from one foot-candle, which is not uncommon in industry, to a moderate level of approximately 20 foot-candles (a condition often occurring upon the installation of a modern lighting system) results in increasing the speed of seeing approximately three times! This enormous improvement in perception and recognition of surroundings affects just about everything the workman does."

Comments and suggestions on the proposed new recommendations will be welcomed by the Illuminating Engineering Society and the American Standards Association. Copies are available from the ASA office.

SAE Adopts Five New Standards, Approves Seventeen Revisions

FIVE new SAE Standards and Recommended Practices were adopted by the Society of Automotive Engineers following action taken by its Council, Jan. 13, during the SAE Annual Meeting. Revisions and extensions of 13 other SAE Standards and Recommended Practices were likewise sanctioned. The Council also approved revisions of four American Standards for which the SAE is co-sponsor under the procedure of the American Standards Association, and which will be submitted to the ASA for final approval. Action of the Council was based upon recommendations of the SAE General Standards Committee and its divisions.

Among the new standards, two were developed by the ball and roller bearing division of the Standards Committee. One, Aircraft Bearings, had earlier been approved by the Army, Navy, and the aircraft industry as well as by bearing manufacturers. The other, Radial Bearings, Extra-Light Series, is the result of cooperation between the American bearings industry and bearing industries abroad, as represented on International Standards Association Committee 4.

Other new SAE Standards are for Voltages for Diesel Electrical Systems, Main and Connecting-Rod Bearings (materials), and Tachometer (Speedometer) Drives.

Revisions of the four following SAE Standards for bearings also were approved by the SAE, as co-sponsor, as revisions of American Standards: Radial, Single-Row Series; Separable (Open) Series; Wide Series; and Angular Contact Series.

Other SAE Standards which were revised are: Lock Nuts and Washers; Storage Battery Specifications; V-Belts and Pulleys; Aluminum Specifications; Zinc Die-Casting Alloys; and Fuel and Oil Tube Fittings.

Extensions and additions of the following SAE Standards were also approved: Radial Bearings with Snap Rings; Automobile Nomenclature; and Crankcase Oil Classification (temperature ranges).

The new standards, revisions, and extensions will be included in the 1939 SAE Handbook, now in preparation.

Argentina Tightens Label Restrictions

Argentina is tightening its labeling restrictions, says a news item in *Business Week*, January 14. A new law recently enacted prohibits the use of "puro" and "pura" on foodstuffs unless special permission is granted.

Standard Tests for Plastics

Uniform tests now being developed by American Society for Testing Materials will aid in checking suitability of plastic materials for various uses

Photos courtesy Bakelite Company

The plastic Bakelite, one of the most popularly known of the plastic materials, is widely used for bottle tops, tube tops, and other closures. The molding material is delivered to the hopper of a rotary preforming machine (above) where it is compressed into tablets and placed in molds of the same shape. Heat of about 350 F and pressure of over 2,000 lb per sq in., applied for less than a minute, transform the molding material into a dense, homogeneous solid.

THE public has become "plastics conscious." Costume jewelry, holders for cigarettes and fountain pens, handles for faucets and for cutlery, and a thousand and one other gadgets have made us all intimately familiar with the beauty and utility of plastics. During recent years improvements in technique have been directed toward the manufacture of larger and larger articles. This has introduced plastics into many new fields, such as housings for radios and scales, lighting reflectors, and moderate sized cabinets. The laminated plastics have also proved to be extremely versatile and are to be found functioning both in a decorative capacity as wall panelling and table tops in hotels and ocean liners and in a purely industrial capacity as gears and bearings in factory machinery and automobiles.

It is but natural, therefore, when an engineer is called upon to design some new article, whether for household or factory, that he will give some thought to the suitability of one of the many kinds of plastics for the purpose in hand. To reach a decision, he must have information about the properties of plastics—the kind of information generally known as engineering data, and published in hand-books.

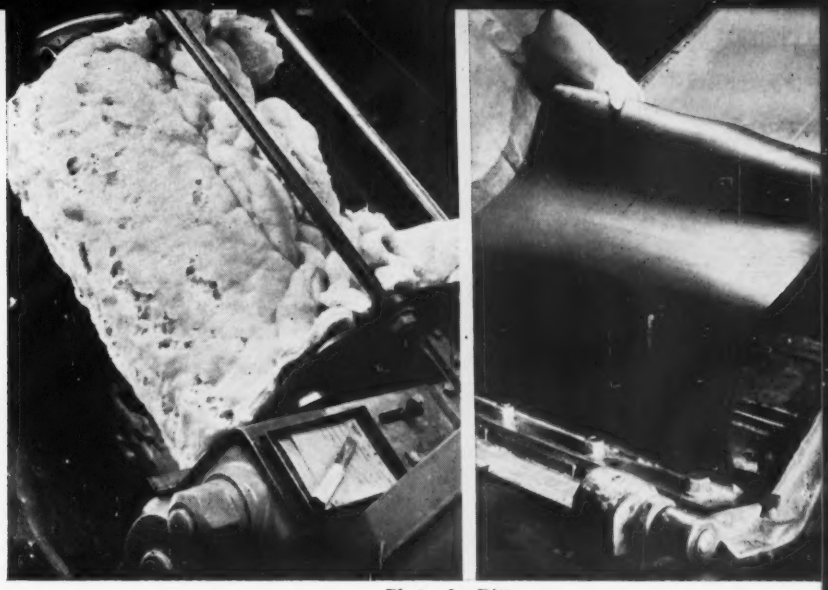
The plastics industry is so new that this kind of information is not yet available. The journal, *Modern Plastics*, publishes annually a table of the properties of these materials, but the 1938 edition carries a caution "Differences in test procedures and sizes of test specimens may lead to erroneous conclusions in some cases if direct comparisons are attempted." Since one is thus cau-

Molded plastics are used for radio cabinets. This is a new type molded Bakelite cabinet.

by

Warren E. Emley[1]

Chairman, Committee D-20 on Plastics, American Society for Testing Materials



Photos by Rittase
Courtesy Plastics Division, duPont Company

"Pyralin," a plastic used in laminated safety glass, is made from pyroxylin—nitrated cotton linters, mixed with camphor and solvents, and worked into a heavy mass. It is put through heavy steel rollers (as shown at the left) until the knots and lumps are pressed out. Pyralin sheets and rods cut from this material (right) are turned into toiletware and hair ornaments, as well as into the very thin sheets used in laminated safety glass.

tioned against comparing the reported tensile strength of cellulose acetate with that of phenol-formaldehyde, how can one compare the tensile strength of either type of plastic with that of wood or steel? In other words, how can the engineer decide whether or not any type of plastic may be substituted for some other, better known material, with assurance of satisfactory results?

Of course, we must remember that the tensile strength of any material, as reported in tables of engineering data, is not an inherent property of the material in the same sense that specific gravity is. The tensile strength as measured depends on the shape and size of the test specimen, the rate of application of the stress, and other factors. For many materials, these factors have been standardized by general agreement, and a wealth of experience has been built up relating the figures obtained from laboratory tests with the performance of the material in service. Obviously, no such experience could have been built up unless and until the agreement as to testing methods had been completed so that results obtained by laboratory testing could be generally compared both with each other and with the performance of the material.

In the plastics industry, the testing methods have not yet been standardized. It is quite possible to show that one type of plastic is better or worse than another, simply by choosing the appropriate values for those factors in the testing method which will bring about the desired laboratory result.

Each manufacturer has found it necessary to give his customers information about the quality of his product. To get this information, laboratory tests are required, and lacking accepted standards, or even precedent, he has been at liberty to choose any testing method he desired. A method has been chosen generally without much knowledge of or regard for similar methods used by his competitors.

Some years ago, the plastics manufacturers realized that the procedure outlined above was leading toward chaos. Each manufacturer had

[1]National Bureau of Standards, Washington, D. C.

Milady finds plastic material useful

Courtesy Plastics Division, duPont Company

The American Society for Testing Materials is a Member-Body of the American Standards Association. Besides membership on the Standards Council and Board of Directors, governing bodies of the ASA, the ASTM has representatives on 47 sectional committees and has the administrative leadership for 15 of these. It is also a member of the Building Code Correlating Committee, the Mechanical Standards Committee, and the Electrical Standards Committee, as well as the United States National Committee of the International Electrotechnical Commission.

In addition to the sectional committees under ASTM sponsorship, which work under the procedure of the ASA, many standards developed by ASTM committees have been submitted to the ASA and are included in the list of approved American Standards. Other standards are now being considered by the Society for submittal to the ASA.

his own testing methods, and was building up a mass of test data which could not be compared with the similar data about any competitor's product. The necessity for explaining this situation to each new prospect made for increased sales resistance. Research for the industry in general was unnecessarily hampered.

The answer was obvious: Adopt standard methods of test.

The manufacturers might have reached an agreement among themselves, and the methods thus agreed to would probably have been accepted by all. Instead, however, they recognized the interest of consumers and testing engineers in this matter. They therefore took advantage of the method of organization provided by the American Society for Testing Materials, whereby all three groups are brought into cooperation toward the desired end. Accordingly, Committee D-20 on Plastics of the American Society for Testing Materials was organized on July 1, 1937.

The general plan of operation of the committee is to select some one property for which a testing method is needed, examine the various methods in use for measuring this property, try out in the laboratories of the members those methods which seem most promising, study the degree of control necessary for the various factors involved, and finally select one method to be recommended to the Society.

The committee at present has 52 members, 24 being producers of plastics, 16 consumers, and 12 "general interest." It is divided into five subcommittees, which are working upon the following problems in their respective fields:

Subcommittee 1 on Strength is developing methods to measure the flexural and tensile strengths of plastics, and a method to measure resistance of plastics to impact.

Subcommittee 2 on Hardness is working on methods to measure the resistance of plastics to abrasion and to scratching and is examining the gradual distortion of plastics under load.

Subcommittee 3 on Thermal Properties is studying methods for measuring flammability and plasticity.

Subcommittee 4 on Optical Properties is examining instruments for measuring haze, and is developing methods for measuring index of refraction and surface irregularities.

Subcommittee 5 on Permanence is preparing methods for measuring the absorption of water by plastics, and the resistance of plastics to attack by chemicals.

It is expected that several of the above methods will be ready for recommendation to the Society at the time of the annual meeting in June 1939.

The variations in the testing methods at present in use in the plastics industry compel the men in the industry to speak different languages. One cannot be sure of the meaning of a figure for tensile strength unless one knows the way in which the strength was measured. In such a thoroughly modern industry, it is but natural that the disadvantages of this situation should be quickly realized, and steps taken to rectify the condition. The work of Committee D-20, American Society for Testing Materials, is directed toward this end. The enthusiastic and continuous support of this work makes certain the speedy accomplishment of the objective.

The acceptance of standard methods of tests will mean that everyone in the industry, producer and consumer alike, will be able to speak a common language.

Plastics Hold Promise For Mass-Production Airplanes

This description of the work being done to develop standard methods for testing plastics is particularly timely now, immediately following two announcements of important new developments in the field of plastics. The first concerns a new "plastic airplane" now being developed.

The fuselage and wings of such a plane can each be machine-molded in a couple of hours, making mass-production possible, according to testimony given by George Baekeland, vice-president of Bakelite Corporation, before the Temporary National Economic Committee, reported in *Business Week*. The first plane with a "Duramold" fuselage is already in operation, has flown several hundred hours, and has been approved by the government.

Plastics are finding other uses in airplanes. The Celluloid Corporation is developing methods of applying its sheet cellulose acetate "Lumarith" as a covering for fuselages and wings, and its Lumarith tubes and shapes as strength members. Other companies have already found a wide use for their plastic materials in airplane instrument panels, control handles, etc.

The second new development in plastics, also reported in *Business Week*, is "coffee plastic," made from unroasted coffee beans, which is being developed by South American interests for the South American market.

The front cover of the December, 1938, issue of INDUSTRIAL STANDARDIZATION illustrates how plastic materials were used by one manufacturing company. The picture shows the transparent plastic model used by the Westinghouse Electric & Manufacturing Company for checking theoretical calculations during the manufacture of the "horseshoe" bearing for the 200-inch Mt. Palomar telescope.

Safety Handbook for Electric Lines Issued by Bureau of Standards

Changes in Part 4 of the National Electrical Safety Code, now being revised under ASA procedure, have been incorporated in a new booklet issued by the National Bureau of Standards as Handbook H34. The section just published is entitled "Safety Rules for the Operation of Electric Equipment and Lines." It contains rules for both employers and employees who have the handling of overhead and underground supply and communication lines and the power stations from which the supply lines receive their energy.

There are six sections in this part of the Code. Three deal with supply systems, two with communication systems, and one is of a general nature. Rules to be followed by employers and those to be followed by employees are segregated so as to bring out the separate responsibilities of each.

The National Electrical Safety Code is now being revised by a sectional committeee of the American Standards Association, and Part 4 which has been completed has been submitted to the ASA for approval. Copies of Handbook H34 are available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

New Foreign Standards Available from ASA

New and revised standards recently received by the American Standards Association from national standardizing organizations in other countries include many subjects of interest to American industry. They are published in the language of the country from which they were received.

When ordering a standard, please include its number.

Australia

Mattresses and pillows for adult-size beds (Com. Std. 10)

Canada

Construction and test of flexible steel conduit (C22.2-No. 56-1938)
Construction and test of knife switches (C22.2-No. 50-1938)
Construction and test of portable electric displays and incandescent-lamp signs (C22.2-No. 7-1938)
Metallic Arc (iron and steel) electrodes for welded steel buildings (S48T-1938)

Great Britain

Carbolic acids 60's (515-1938)
Chemical symbols and abbreviations (813-1938)
Cresylic acid of high or thocresol content (517-1938)
Cresylic acid (50/55 per cent metacresol) (521-1938)
Orthocresol metacresol and paracresol (522-1938)
Phenol (523-1938)
Refined cresylic acid (524-1938)
Methods for testing glues (bone, skin, and fish glues) (647-1938)
Modified technique of the chick-martin test for disinfectants (808-1938)
Methods for the sampling of dairy produce (809-1938)
Two-and three-terminal ceiling roses (67-1938)
Overhead line-wire material (non-ferrous) for telegraph and telephone purposes (174 to 181-1938)
Galvanized iron and steel wire for telegraph and telephone purposes (182 to 184-1938)
Terms and definitions applicable to hardwoods and softwoods (565-1938)
Motor starters and controllers and resistors employed therewith (587-1938)
Plain linoleum and cork carpet (810-1938)
British standard cycles threads (811-1938)
Methods for the sampling and testing of mineral aggregates, sands and fillers (812-1938)
Mild steel drums for lubricating oils (814-1938)
Under-floor non-metallic ducts for electrical services with fittings (815-1938)

Standard Marking to Assure Quality of Gold Articles

by

W. H. Blake

Associate Secretary, New England Manufacturing Jewelers' & Silversmiths' Association

THE National Stamping Law which became effective in June, 1907, provides that in articles of merchandise made in whole or in part of gold or any of its alloys, the actual fineness of such gold or alloy shall not be less by more than one half of one karat than the fineness indicated by the mark stamped, branded, engraved, or printed upon any part of such articles, or upon any tag, card, or label attached thereto, or upon any box, package, cover, or wrapper in which such article is incased or inclosed. It also provides that the parts taken for assay shall contain no solder. The law exempts watch cases and flatware from this provision, requiring that these articles shall not be less by more than three one-thousandth parts than the fineness indicated.

These requirements would seem at first glance to cover fairly well the needs of the industry. It was found, however, that there were many instances where articles were so marked that the general purchasing public was deceived as to the actual quality of articles of jewelry purchased. In some cases portions of the articles were made of inferior metals and the claim made by the manufacturer that such portions did not purport to be of gold or any of its alloys, and that they did not therefore come under the provisions of the National Stamping Law. Some items, particularly rings, were made with hollow portions and these portions filled with some non-metallic substance, thereby increasing weight without corresponding value. In many instances, articles were marked "Solid Gold" without any karat mark to indicate the fineness of the gold alloy used. Such marking was used on very low grade gold, perhaps 6 Kt or less, which meant that by far the greater portion of the article was in reality composed of an inferior metal.

Recognizing these conditions, and also the probable delay which would accompany any attempt to secure passage by the Congress of a new National Stamping Law, the New England Manufacturing Jewelers' and Silversmiths' Association, with headquarters in Providence, Rhode Island,

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The Commercial Standard for Marking Articles Made of Karat Gold (CS67-38), promulgated by the National Bureau of Standards, has been approved by the American Standards Association. It was submitted to the ASA by the New England Manufacturing Jewelers' and Silversmiths' Association which, with the Jewelers Vigilance Committee, was responsible for the request to the National Bureau of Standards for development of a Commercial Standard. The jewelers' action in submitting the standard to the ASA was taken as the result of arrangements between the Advisory Committee on Ultimate Consumer Goods of the American Standards Association and the National Bureau of Standards.

Two other Commercial Standards relating to the manufacture and marketing of articles containing gold have been approved by the ASA. These are Marking of Gold Filled and Rolled Gold Plate Articles Other than Watch Cases (CS47-34) and Marking Articles Made of Silver in Combination with Gold (CS51-35).

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started action to present to the National Bureau of Standards a proposed Commercial Standard for the marking of articles made of karat gold. In these efforts, they received the active cooperation of the Jewelers' Vigilance Committee of New York, of its chairman, G. H. Niemeyer, and its counsel, Byron L. Shinn. Various conferences were held by the Stamping Law Committee of the New England Manufacturing Jewelers' & Silversmiths' Association, and its representatives, with the New York group. Meetings of interested manufacturers were held both in Providence and New York, and a proposed standard was approved and submitted to the National Bureau of Standards.

As the proposed standard covered not only jewelry but watch cases and optical goods as well, groups representing makers of these articles were also consulted. Many abuses had already been corrected to a great extent by voluntary agreement on the part of the optical goods manufacturers, but they heartily approved of the proposed standard and cooperated in its acceptance, as did the manufacturers of watch cases. Preliminary meetings were held in Providence, followed by a general conference in New York in January, 1938, presided over by I. J. Fairchild, chief of the Division of Trade Standards of the National Bureau of Standards. At this conference representatives of the interested manufacturers were present. The provisions of the proposed standard were fully discussed and with a few minor changes were adopted by the conference.

The standard was sent out for acceptance in the usual course of procedure, and gained very general acceptance at once. It became effective for new production from November 25, 1938, and for clearance of existing retailer stocks from November 25, 1939.

The standard does away entirely with use of the term "Solid Gold." It provides that articles made of a quality less than 10 karat or with hollow portions filled with pitch or other materials may not bear any quality mark. It further requires that any article bearing a quality mark shall also be marked with the name of the manufacturer or with a trade mark duly applied for or registered under the law of the United States.

The same tolerances are allowed as are provided for in the National Stamping Law. Certain exemptions are recognized as to parts not to be included in any assay for quality for both the jewelry and optical industry. These exemptions include such items as springs, posts, rivets, etc. which for mechanical reasons must be made of some other material.

The standard is brief and simple. However, it appears to cover the situation very well and its acceptance should do away with abuses and prove a great benefit to both manufacturers and ultimate consumers.

Need Prompt Action on Uniform Inspection Code, Automotive Engineers Hear

Prompt formulation of a uniform inspection code was urged at the annual meeting of the Society of Automotive Engineers during the week of January 9 by Sidney J. Williams, director of the Public Safety Division, National Safety Council. Mr. Williams said that with inspection being the country, the need for a standard guide for inspection practice is becoming increasingly urgent. tion practice is becoming increasingly urgent.

"We face a condition and not a theory," he told the automotive engineers. "Brakes are being tested, inspection certificates are being given or withheld in a growing number of official stations all over the country, using equipment now commercially available—whether we like it or not. The more time elapses before an accurate, practical standard is agreed upon the more difficult will it be to change established practices. Time is of the essence of this undertaking."

A committee of the American Standards Association has already prepared three sections of a standard code for inspection of motor vehicles which are now undergoing editorial revision. The final draft is expected to be presented to the ASA for approval soon.

Mineral Wool Association Reports Results of Tests

An 88 per cent increase in production of mineral wool bats and strips during the third quarter of 1938 over that of the first quarter and a 37 per cent increase over the second quarter was reported by the National Mineral Wool Association in December.

An important feature of the period covered was a report* by the National Bureau of Standards of tests carried out according to the provisions of the American Standard Specifications for Fire Tests of Building Construction and Materials. These tests gave an ordinary wood stud partition, finished with wood lath and plaster, a one-hour fire rating, and one finished with metal lath and plaster a one-and-a-half hour rating. The partitions were subjected to all the tests for duration under fire and fire-hose stream required by the American Standard. **(See page 257, November, 1938, issue of* INDUSTRIAL STANDARDIZATION.*)*

Harvard Business School Reports On Testing as Consumer Guide

A Review

by

Mrs. Carol Hyatt Moffet

Mrs. Moffet, who reviews the new book, *Merchandising Testing as a Guide to Consumer Buying* by Mabel Taylor Gragg in collaboration with Neil H. Borden, has had considerable experience herself in writing for the consumer. She was one of the authors of a series of purchasing pamphlets for the Household Finance Corporation which have had wide circulation. As a result of the work she did on these pamphlets she developed a wide knowledge of consumer problems and an intense interest in them. She was recently named as a member-at-large on the Advisory Committee on Ultimate Consumer Goods of the American Standards Association.

FOR the first time, the business school of a university has published a report in the comparatively new field of rational consumer buying. *Merchandise Testing as a Guide to Consumer Buying*, by Mabel Taylor Gragg, in collaboration with Neil H. Borden, is part of a project concerning the economics of advertising being undertaken at the Graduate School of Business Administration of Harvard University. Howard T. Lewis, director of research, says in the foreword to Mrs. Gragg's study:

"One segment of this project has inevitably dealt with the growing demand for some rational basis by means of which consumers can intelligently judge the satisfaction which merchandise, particularly advertised merchandise, is likely to give them."

It is unfortunate that in the 84 quarto pages that follow, the issue has been confused rather than illumined. Mrs. Gragg has not defined for herself nor her readers what she means by "value," "evaluation," or "standards," and uses these words differently in different contexts. Similar confusion arises over what consumer attitudes and problems are, what the objectives of evaluation are, why analysis and performance tests are developing, and why specifications and standards are proving useful tools for large- and small-scale buyers. As a result, the conclusions in the final chapter on 'Significance of the Study for Programs of Consumer Guidance" go little beyoid the program which has been followed for years by Better Business Bureaus, and which, valuable as it has been, does not fulfill important needs of present-day consumers.

One reason why this report falls so far short of the expectations with which one approaches it is a lack of perspective. Most of the report is given to illustrations and quotations which emphasize the difficulties encountered by technicians, understandably baffling to the layman. Mrs. Gragg apparently concludes that the ingenuity, skill, and intelligence which have created countless new products and improved old ones are incapable of devising accurate and practical ways of measuring and stating product characteristics which determine relative merit and satisfaction in use. Because present methods are imperfect she continuously says the job "cannot be done," apparently forgetting that radios, airplanes, and rayon, to mention only a few of the more recent triumphs of skill, also had imperfect beginnings and are still not perfect products.

There is no mention of the progress that has been made in the relatively few years during which the merchandise evaluation problem has

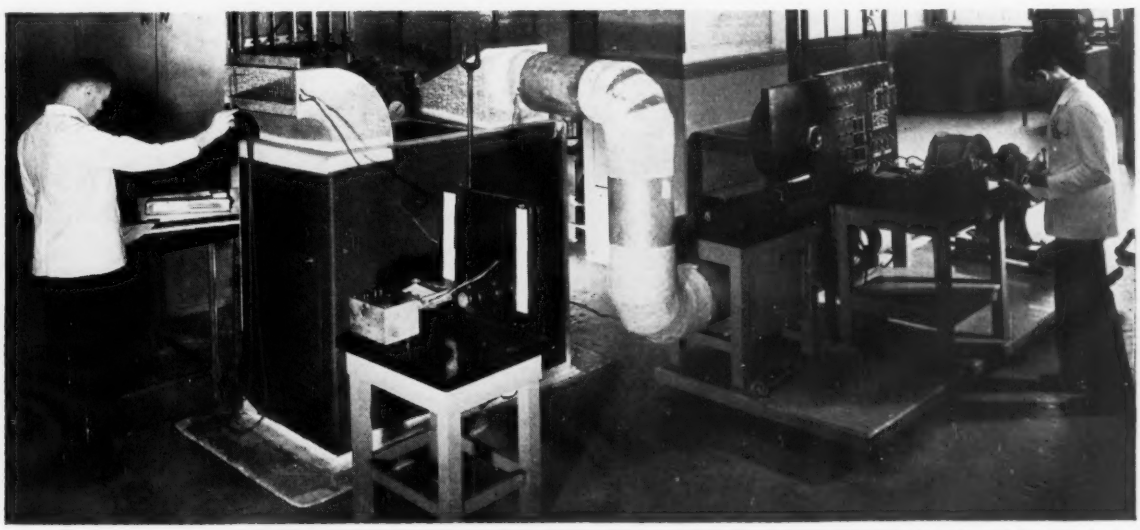
been tackled scientifically. When technicians differ in opinion and have a wholesomely critical attitude toward their achievements to date, she assumes this to be proof that the problems are unsolvable, rather than evidence of the striving for improvement in a highly complex undertaking. Those who have attended any of the numerous conferences at which differences of opinion are slowly being resolved and imperfect methods improved, believe that merchandise testing is not a static thing but a typical example of the evolving techniques of the industrial age.

Another reason for the inadequacy of the report is the method followed. The usual procedure in academic research is to see the problem whole, ask the important questions, and define the terms used. When this is not done, confusion is inevitable.

Problem to Evaluate Products

Though Mrs. Gragg states at the outset that she has relied upon her own experience as a consumer "to provide insight not only into the problems faced by consumers but also into their attitudes toward these problems," she cites in the next chapter "the necessity for evaluating merchandise with a specific income group in mind," and then concludes that "any intelligent plan for guiding consumers must begin by stating for what classes of consumers the guidance is intended." Persons in a very wide income range and in all classes of the population buy such diversified products as mechanical refrigerators, silk stockings, and canned tomatoes. The problem is not that of evaluating individuals, but of evaluating products. *Any* individual should be enabled to select intelligently the products best suited to *his* needs and purse.

The fundamental confusion on this point permeates the report and renders irrelevant much of the material on test methods, standards, and specifications. In the last analysis, standards and specifications are merely agreements among makers, sellers, and buyers on ways of measuring and stating product characteristics which determine relative merit and satisfaction in use. Yet Mrs. Gragg says in chapter two: "The problem is not the simple one of setting a high standard without regard to costs, prices, and consumers' incomes." No conferees on standards have ever, to my knowledge, contemplated doing this. In chapter three she states: "In view of the many differences which exist among consumers and the practical impossibility of bringing into combination conflicting product virtues, it is clear that no single product form can be best for everyone." And in chapter four: "When a standard becomes more than a minimum requirement for full protection of health and safety, however, and is intended to be a statement of worth, then insistence that all production should be in accordance with it clearly would presuppose a basic change in our social structure." These three statements serve to indicate misconceptions about the nature and pur-



Courtesy American Gas Association

Gas-burning appliances which meet the requirements of standard tests may carry the Seal of Approval of the American Gas Association for consumers' information. Many of the tests used by the AGA Testing Laboratory are approved American Standards.

pose of standards which recur frequently throughout the report.

The objectives of evaluation are similarly confused because relevant questions are not asked. The underlying assumption in chapter three on "The Process of Evaluation" seems to be that classifying products, selecting characteristics for measurement, devising satisfactory test methods, and informing consumers are based on arbitrary individual decisions, whereas they are in fact based on consideration by representative interests of such questions as: For what purpose is this product intended? How well, relative to other products designed for the same use, does it perform in service? What is the relation between performance, upkeep, and price? Processes of evaluation do not become widely accepted and used until the questions to be answered and methods for answering them are agreed upon in conferences of technicians. Individual research and experience form the basis for conference agreements.

"Risk" Is Necessary

In the chapter on analysis and performance tests, examples are chosen of tests in the process of development. Because they do not provide perfect results, it is concluded that they "make clear risks to consumers" who rely upon them for guidance in buying. How they are to be improved without use and experience, she does not consider. Yet because many consumers preferred to "risk" buying the first automobiles, we have the cars of 1939.

Though no supporting evidence is given, Mrs. Gragg states categorically that government specifications "are drawn for a particular firm for specific purposes." Starting with such an astonishing misconception, no valid conclusions could be expected. Consequently, in discussing government specifications, six pages out of eight are devoted to traffic paint, from which it is concluded that "it is not safe to argue by analogy when discussing consumer buying in relation to government buying." The analogy made by representative consumer organizations is: Since it is possible for makers and sellers to reach agreements with government procurement officials on specifications and standards as a basis for bids, it should be possible for them to reach similar agreements with consumers as a basis for rational selection.

In view of the fact that no consideration is given to study of the objectives of the consumer movement, the progress already made in merchandise testing, or such important work as standards for sizing children's garments, it is not surprising that Mrs. Gragg's suggestions for future programs fall short of current developments. Nor is it surprising, in view of the misconceptions which characterize this report, that she concludes: "The limitations upon the evaluation of merchandise for ultimate consumers are many and grave."

Merchandise testing is an infant in the hoary company of buying and selling. That its lusty shouts have attracted the attention of business schools is encouraging. So gigantic is the task of rearing this baby to maturity, that it is hoped more business schools will enter the growing roster of foster parents.

Standard Box Car and Package Dimensions Would Save for Railroads and Shippers

THERE is an economic factor in freight train car construction which has not been given the consideration it deserves—I refer to the cubical capacity of house cars in relation to packages or containers. The standard box car of some years ago was 36 ft x 8 ft 6 in. x 8 ft 6 in. The Association of American Railroads' present standard box car for unrestricted main line operation has the following dimensions—40 ft 6 in. x 9 ft 2 in. x 10 ft 0 in. The trend is to build cars of ever-increasing cubical capacity.

There is obviously a practical as well as engineering limit to the inside dimensions to which a railroad car can be built. The safe limit of center of gravity for a loaded car was for many years considered 72 in. maximum. Today some loaded automobile cars have a center of gravity of about 92 in. if body and trucks are considered as one unit, and 100 in. if weight of trucks is excluded.

It is the speaker's humble opinion that the individual railroads are more or less helpless to solve this problem, and that the only body which could successfully handle it would be the Association of American Railroads.

Some railroads are fortunate in having road clearances permitting the building of large cubi-

cal capacity cars which puts them in a favorable position as far as shippers of light-weight package freight are concerned. As a concrete example, one railroad recently was favored by a certain shipper because six more boxes of freight could be loaded in its car. Investigation disclosed that the car of the favored railroad was 3/8 in. higher, otherwise a car from another railroad had identically the same dimensions.

If the cubical capacity, or the rectangular dimensions of, say, a box car, were definitely fixed, based on standard packing boxes or containers, all railroads would have the same responsibility and privileges.

Should Study Signs

A thorough study should be made, probably in conjunction with the National Bureau of Standards and the American Standards Association, as to sizes of various cartons and shipping boxes with the view of cooperating with manufacturers to obtain standard sizes of packages.

As an example, cartons used by shoe manufacturers are standard for both men's and ladies' shoes. Assume that a dozen shoe cartons would represent the next size shipping box for shoes and a still larger container for a gross of shoes, and these two larger shoe containers would be of the same dimensions as other containers used for different commodities. If this could be accomplished, we would have an economical house car and it would greatly facilitate door-to-door delivery, standardize highway trucks, and save floor space in warehouses. It is a big problem, but it is not insurmountable, particularly as it would benefit both railroads and shippers. Undoubtedly in some instances it would also mean a reduction in freight tariffs, and would solve the difficult problem of containers for shipment of less than carload lots.

Design

The designer of today in all industrial fields has far more difficult problems to solve than he had 25 years ago. This is particularly true in the railroad field. The whole railroad machine has accelerated in speed so that engineers have not been able to keep pace. In addition, new materials, or improvements in old products, have developed faster than we have been able to definitely ascertain their merits. Being conscious of the fact that he must keep reasonably up-to-date with new developments, an engineer is forced to take reasonable chances. Real progress is a series of experiments, some poor, some good. The good or successful experiments are in greater number than the poor ones. Let us, therefore, be charitable in any new development as long as it is based on sound engineering practice and as long as the general trend is forward.

K. F. Nystrom, mechanical assistant to the chief operating officer of the Chicago, Milwaukee, St. Paul and Pacific Railroad, suggests that the railroads, with the National Bureau of Standards and the American Standards Association, study the possibility of developing standard dimensions for cartons and shipping boxes as first step toward economical standard box cars.

This article is part of an address given by Mr. Nystrom before the Western Railway Club, Chicago, November 21, 1938.

A breakdown of the component parts of the AAR recommended standard box car indicates that 60 per cent is steel, 27 per cent castings, and 13 per cent lumber. We will assume that in car design in the past 16,000 pounds unit stress was generally considered safe practice based upon a steel having a yield point of 30,000 pounds. The new high-tensile steels have a yield point of approximately 50,000 pounds, or an increased strength of 67 per cent, permitting the use of a safe unit stress of about 24,000 pounds. On this basis, assuming that cars built in the past were not too strong, the safe weight reduction of employing high-tensile steel would be a maximum of 9,300 pounds. However, casting parts amount to 27 per cent of the weight of the car, which is equivalent to 12,500 pounds. If high-tensile steel is substituted for castings, a further saving in weight reduction can be made. Therefore, the assumption that approximately 10,000 pounds saving can be made in weight is based on the consideration that further savings can be made in this group.

A lightweight car can be built of high-tensile steel without increasing the cost of the car if full advantage is taken of the possibilities offered by the use of steel. This is due to the fact that while the cost of high-tensile steel today is approximately 50 per cent higher than ordinary carbon steel, its strength, as mentioned previously, is 67 per cent higher. However, there are of course practical limitations in using high-tensile steel, such as in the thickness of plates and parts subject to wear and corrosion.

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